

Hot-Dip Galvanized Steel Bridge Preservation



An overview on the performance, specification, design, fabrication, construction and inspection of hot-dip galvanized steel bridges.

Presenter Information, Event Name & Date

galvanizeit.org

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PROTECT STEEL BRIDGES WITH HOT-DIP GALVANIZING

LOW LIFE-CYCLE COST | DURABILITY | SUSTAINABILITY

USACE FORT WINGATE BRIDGE REPLACEMENT

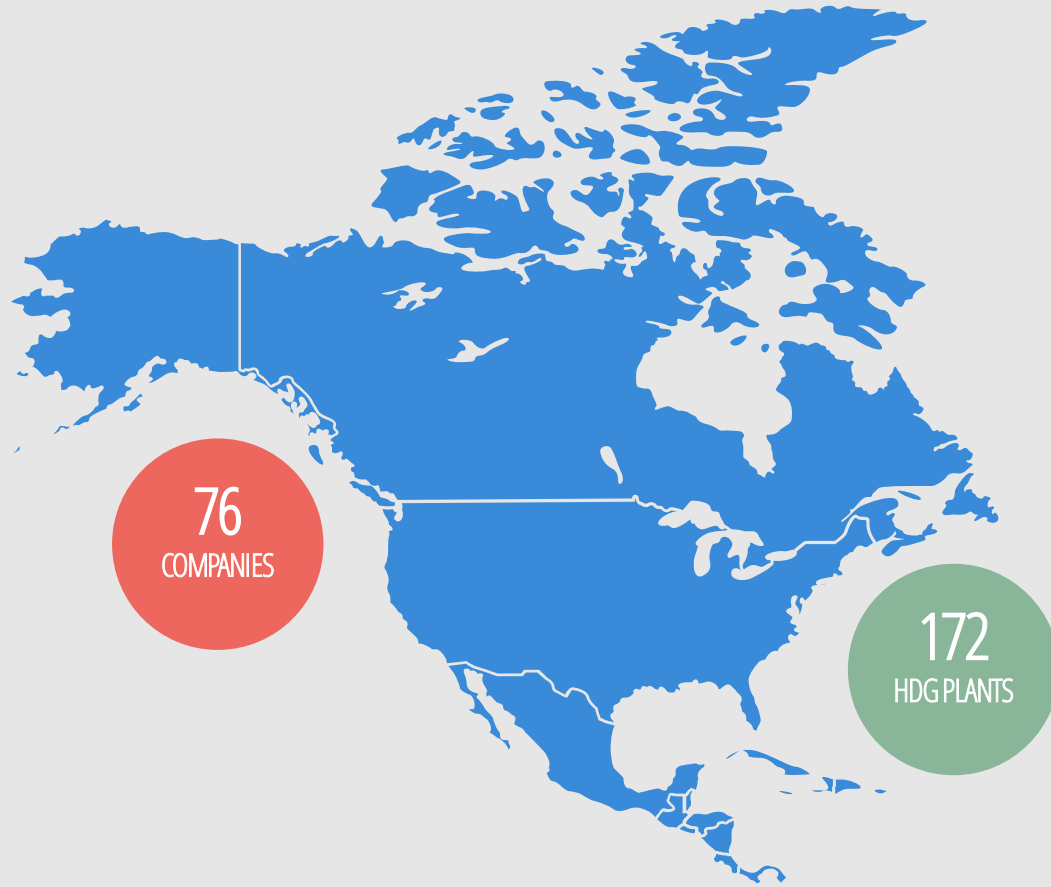
Gallup, NM | 2022

52 tons – Press-brake-formed steel
tub girder: 8 beams weighing
12,600 lbs. each



About the American Galvanizers Association (AGA)

Non-profit trade organization established in 1933



Technical

The AGA provides technical support on the performance, design, inspection and specification of HDG steel

Marketing

The AGA provides its members with sales & marketing support and serves as the unified voice of the industry

Specifiers

The AGA is a free resource to North American specifiers and provides guidance on specifying HDG steel

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LOW LIFE-CYCLE COST

- Enables 100-year bridge design for sustainable infrastructure
- Proven history in bridge applications



SUSTAINABILITY

- Zinc and steel are naturally occurring, abundant elements
- Both are 100% recyclable w/o loss in properties



DURABILITY

- Durable, economical corrosion protection with minimal upkeep
- Suitable for most bridge applications: superstructure, substructure, reinforcing steel, buried structures, sign structures, guardrail, etc.





TURNAROUND TIME

- Factory-controlled
- No humidity requirements or curing
- Optimizations available to improve turnaround



AVAILABILITY

- 180+ hot-dip galvanizing plants in North America
- Average kettle size: 40 ft long, 8 ft deep, 6 ft wide
- Variety of products from fasteners to large structural members



AESTHETICS

- Natural gray finish that blends seamlessly into its surroundings
- Weathers to a neutral, non-reflective, matte gray patina
- Duplex system (HDG + paint) offers endless aesthetic options

AGA TOOLS & RESOURCES

ESSENTIAL RESOURCES FOR SPECIFYING HOT-DIP GALVANIZED STEEL

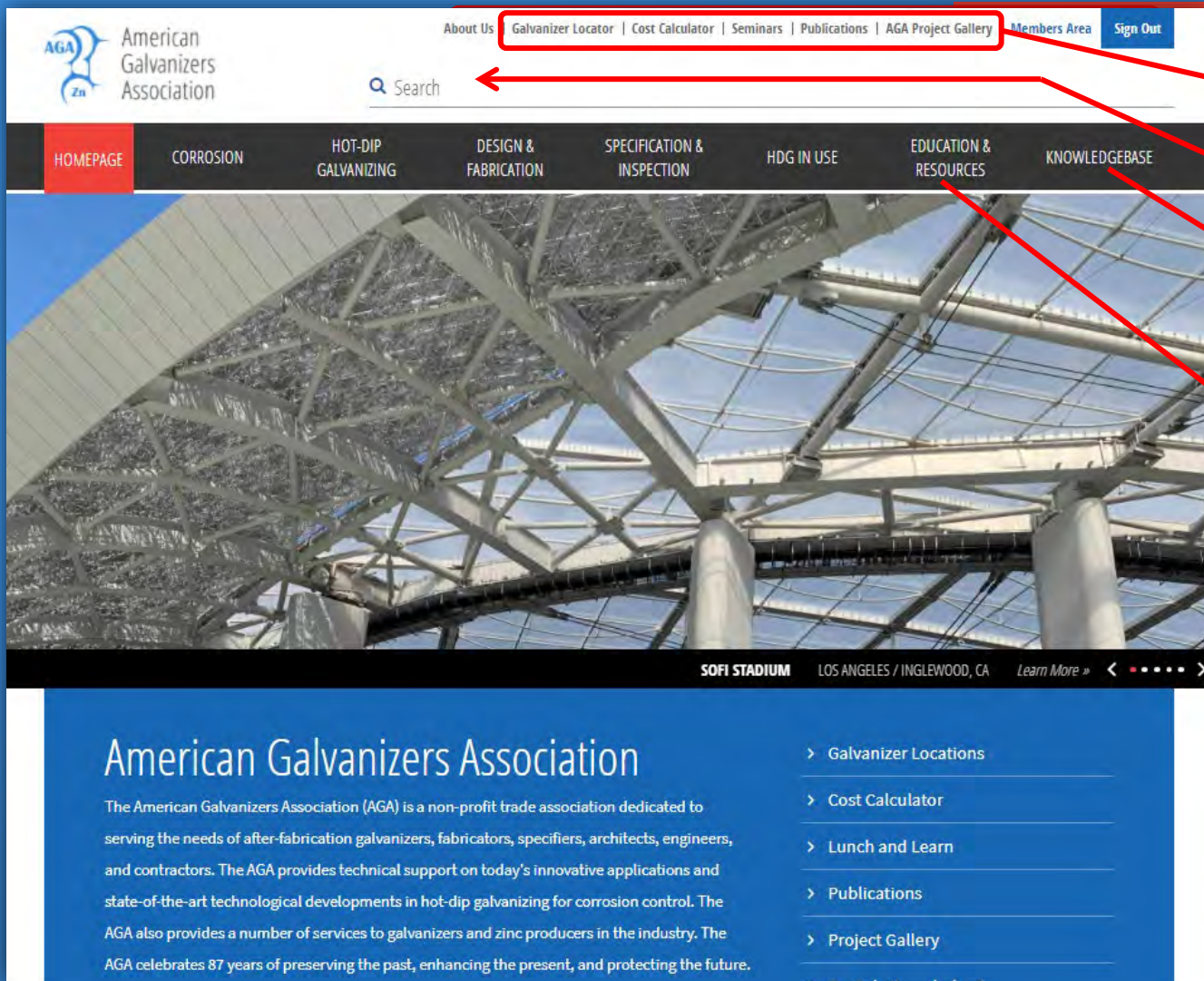
OGDENSBURG-PRESCOTT BRIDGE REHAB

Ogdensburg, NY | 2021

442 tons – Main span bridge
decking, structural steel floor
beams and stingers



Website - Galvanizeit.org



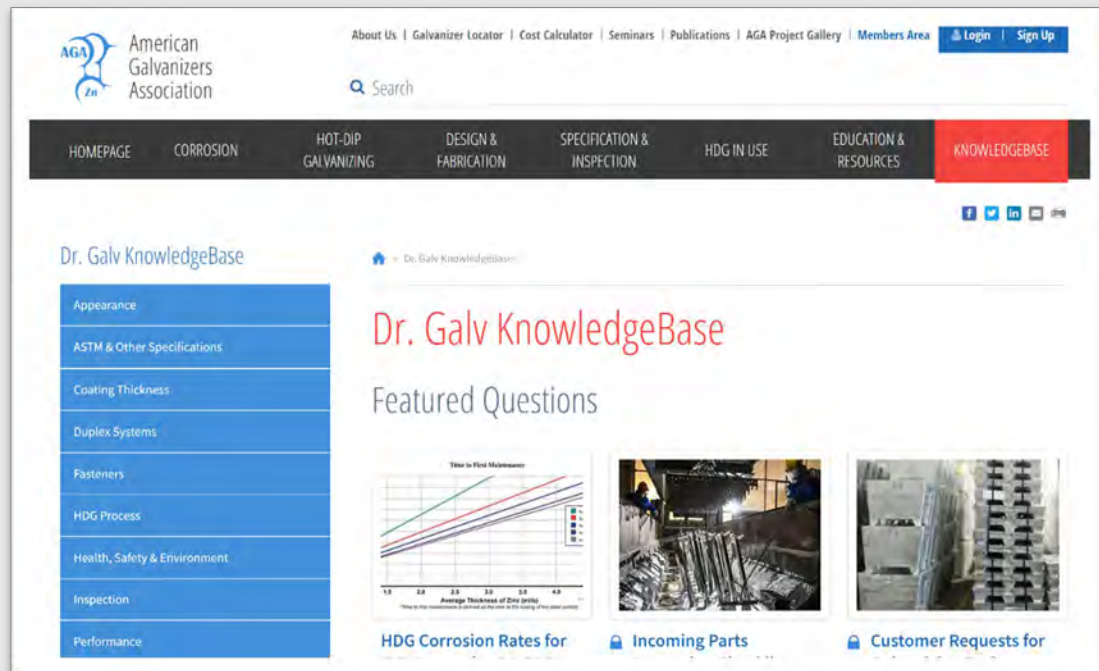
Tools & AGA Resources

Robust Search Function

Knowledgebase

Education & Resources

Dr. Galv™ Knowledgebase



- More than 400 short form Q&A articles
 - Organized by category
 - Visible using search function
 - Some are member protected
 - HDG Process
 - Environmental Health & Safety
- Designed to answer specific FAQs about anything galvanizing
- Technical expertise tailored to galvanizers

Technical Expertise

- Dedicated Process, Coating, Performance, Health & Safety staff
 - address all questions—serious or silly—with professionalism, expertise, and access to an extensive technical library.
- Members & Specifiers call/email for help with specifications, calculations, conversions, or any technical concerns.
- If the AGA doesn't have an immediate answer, they will either connect with the right experts or explore the issue as a potential research topic.

DR. GALV





Knowledgebase Design & Fabrication



Design & Fabrication

Design Considerations

Corrosion protection begins at the drawing board, and regardless of what protection system is specified, it must be factored into the products design. Similarly, all corrosion protection systems require certain design details and proper planning to ensure the highest quality coating. For hot-dip galvanizing, a total immersion process in molten zinc, the design engineer will want to ensure all pieces are fabricated suitably for the process. Most design principles necessary for success throughout the galvanizing process are easily and readily followed, and in most cases, ensure maximum corrosion protection. Incorporating these design practices along with those listed in *ASTM A315 Practice for Providing High Quality Zinc Coatings (Hot-Dip)*, will not only produce optimum quality galvanized coatings, but also help reduce costs, improve turnaround times, and ensure the safety of galvanizing personnel.

Select a topic from the alphabetical list below to view detailed information on each subject:

- [Architecturally Exposed Structural Steel \(AESS\)](#)
- [Bend Diameters](#)
- [Cold Worked Steels](#)
- [Dissimilar Steel Chemistries](#)
- [Dissimilar Metals in Contact](#)
- [Distortion & Warping](#)
- [Fasteners, Bolts, & Nails](#)
- [Hole Sizes](#)

Design Considerations



Design Guide

The Design of Products to be Hot-Dip Galvanized After Fabrication

Design Guide



FABRICATION & DESIGN DETAILS FOR GALVANIZING

American Galvanizers Association • galvanizeit.org • 720.554.0900

The poster contains various diagrams and text boxes detailing fabrication and design requirements for galvanizing, such as 'Corner Connections', 'Welds', 'Fasteners', and 'Hole Details'.

Design Poster

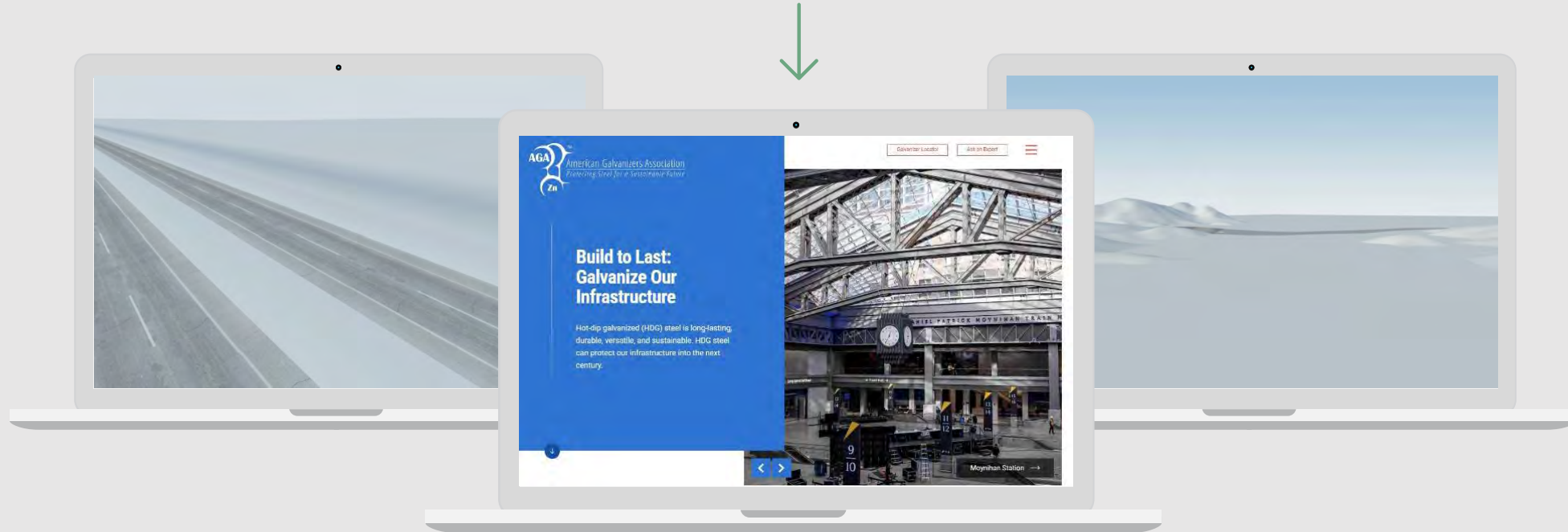


HDG Markets & Products Website

<https://markets.galvanizeit.org>

- Website Highlighting HDG Projects & Technical Info
- Organized by Market/Product Type & State/Provinces
- Animations Highlight the Various Uses of HDG Steel

 Visit Website

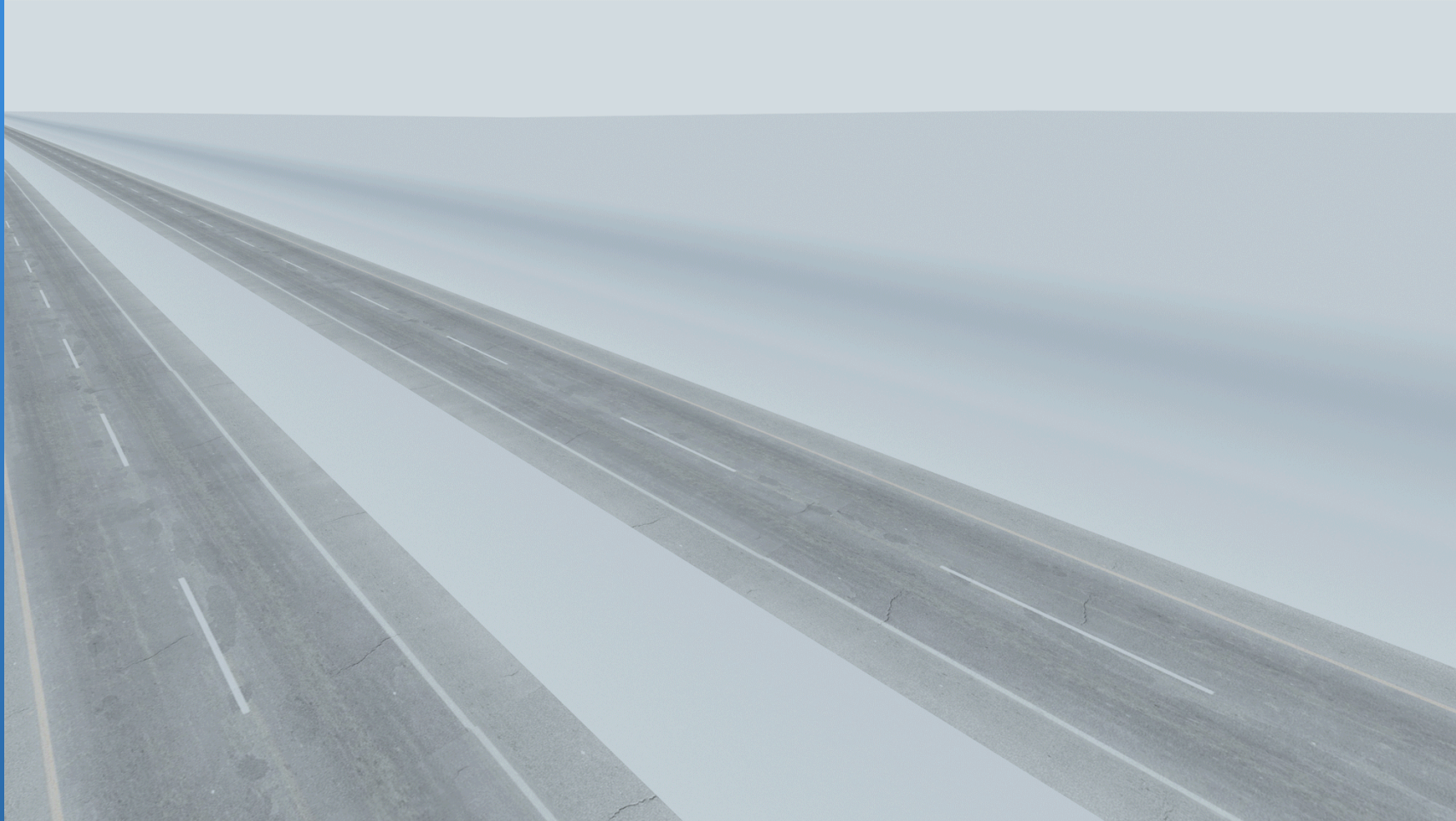


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HDG Components in Bridges & Highways

markets.galvanizeit.org



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“Galvaniz-able” Steel Bridge Components

Nearly all steel components on a bridge can be hot-dip galvanized to maximize longevity



Superstructure

- Base Plates
- Beams
- Bearing Plates
- Cables
- Cross-Bracing
- Diaphragms
- Expansion Joints
- Girders
- Splice Plates
- Trusses



Substructure

- Abutments
- Anchor Bolts
- Buried Bridges
- Dams
- Ground Anchors
- H Piling
- Pile/Pier Caps
- Pier Piling
- Sheet Piling
- Wing walls



Decking

- Curb Angles
- Drainage Supports/Systems
- Floor Grating
- Flooring Grid
- Reinforced Wire Mesh
- Reinforcing Steel
- Scuppers & Drains

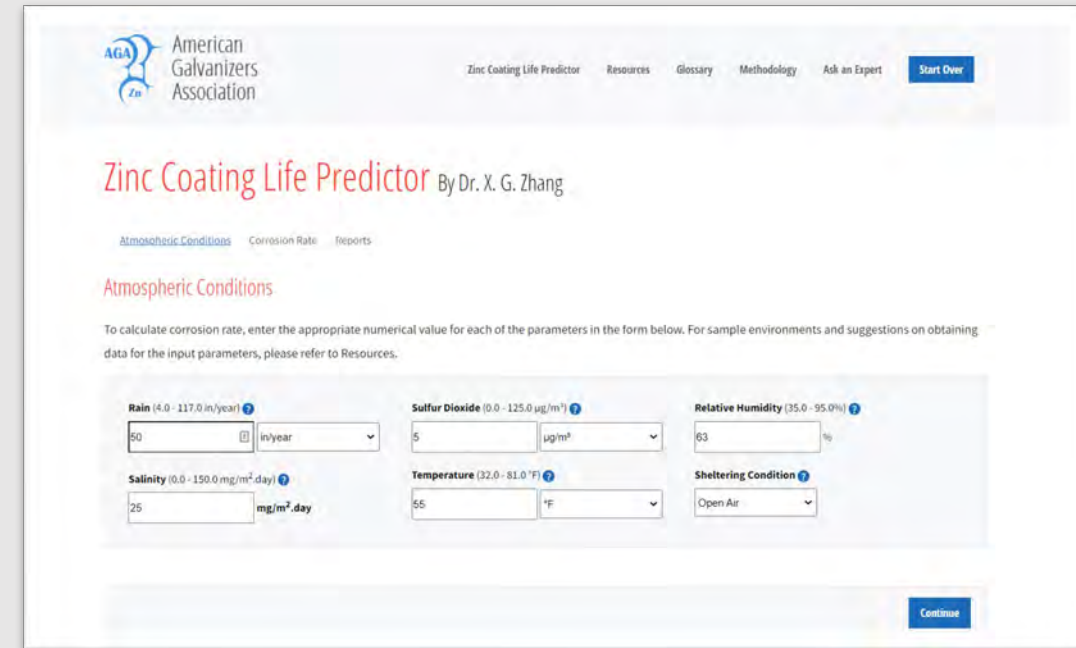


Ancillary

- Box Rails
- Catwalks
- Fasteners
- Barriers
- Ladders
- Light Poles
- Piping
- Sign Supports

Zinc Coating Life Predictor

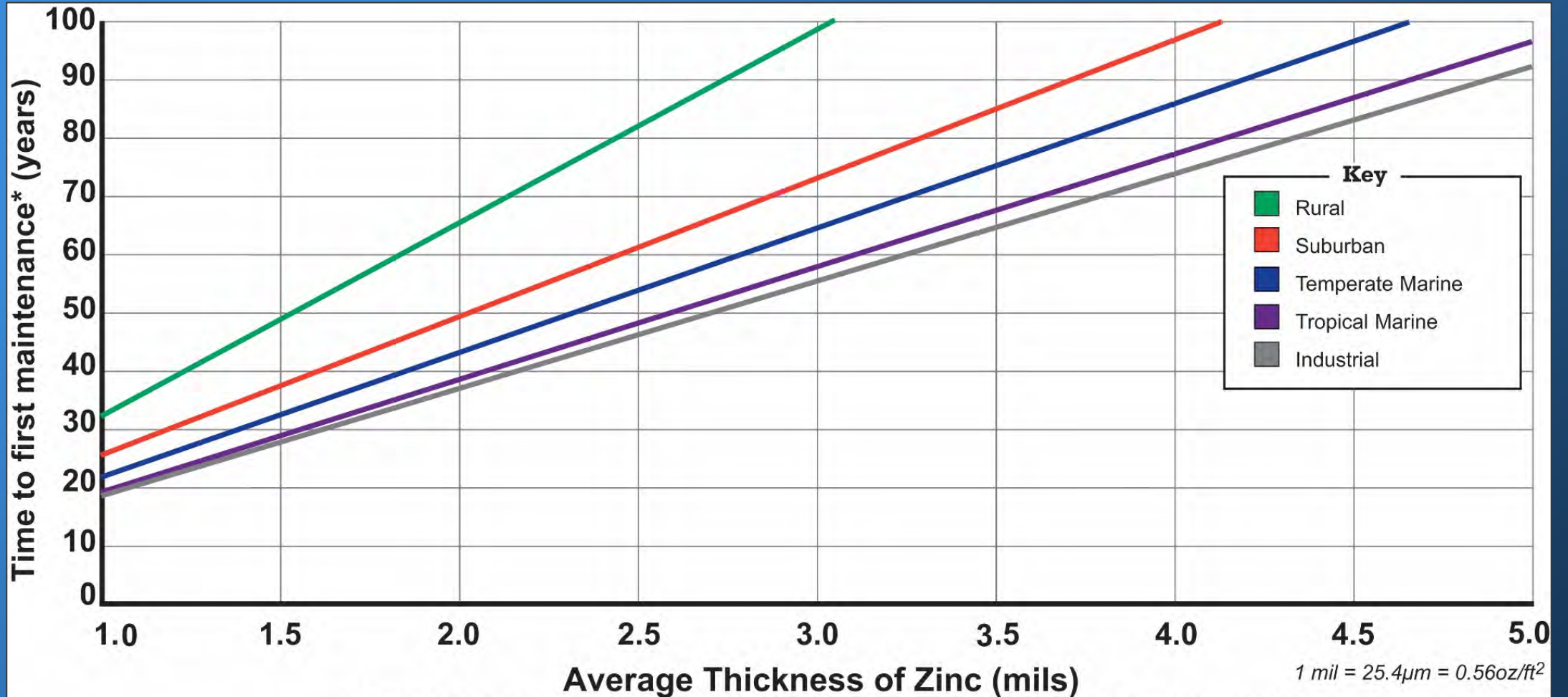
- Estimate the corrosion rate of zinc (galvanized) in various environments
 - Statistical Methods
 - Neural Network Technology
 - Extensive Worldwide Corrosion Database
- Users Guide w/ Links to Collect Local Data
 - <https://galvanizeit.org/knowledgebase/article/the-zinc-coating-life-predictor>
- Used to develop our Time-to-First Maintenance Chart
- **ZCLP.galvanizeit.org**



The screenshot shows the web application interface for the Zinc Coating Life Predictor. At the top, there is a navigation bar with the American Galvanizers Association logo and links for 'Zinc Coating Life Predictor', 'Resources', 'Glossary', 'Methodology', 'Ask an Expert', and a 'Start Over' button. The main heading is 'Zinc Coating Life Predictor' by Dr. X. G. Zhang. Below this, there are tabs for 'Atmospheric Conditions', 'Corrosion Rate', and 'Reports'. The 'Atmospheric Conditions' tab is active, showing a form with the following fields: Rain (4.0 - 117.0 in/year) with a value of 50; Sulfur Dioxide (0.0 - 125.0 µg/m³) with a value of 5; Relative Humidity (35.0 - 95.0%) with a value of 63; Salinity (0.0 - 150.0 mg/m² day) with a value of 25; Temperature (32.0 - 81.0 °F) with a value of 55; and Sheltering Condition with a value of Open Air. A 'Continue' button is located at the bottom right of the form.



Time to First Maintenance Chart



*Time to first maintenance is defined as the time to 5% rusting of the steel surface.

Soil Charts

Evaluate Chloride Concentration

> 20 PPM use Charts 1 & 2

- Evaluate Moisture Content
- Evaluate pH

< 20 PPM use charts 3 & 4

- Evaluate pH
- Evaluate Moisture Content

*NOTE: Service life is defined as the time to necessary part replacement (total zinc consumption + 25%)



Soil Chart
(PDF)

High Chlorides >20 PPM

CHART 1

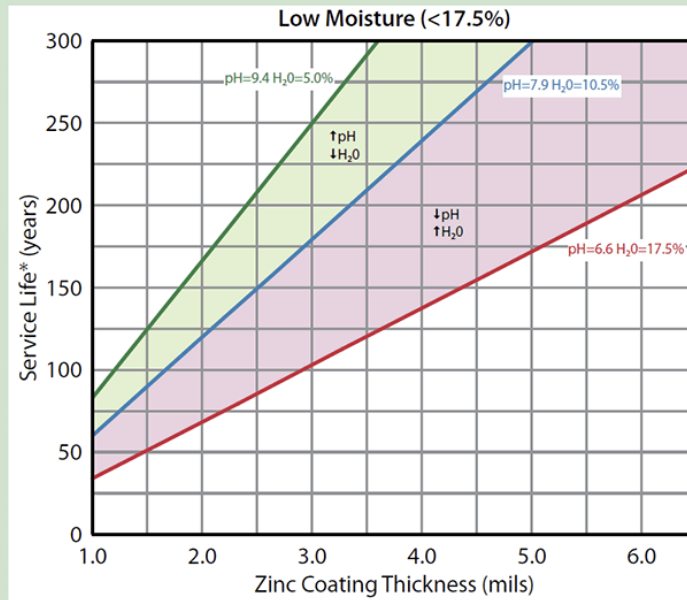
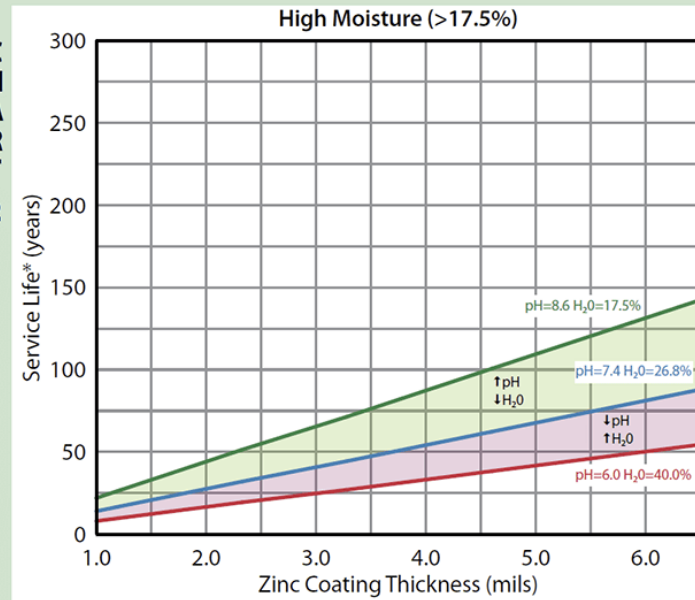


CHART 2



Low Chlorides <20 PPM

CHART 3

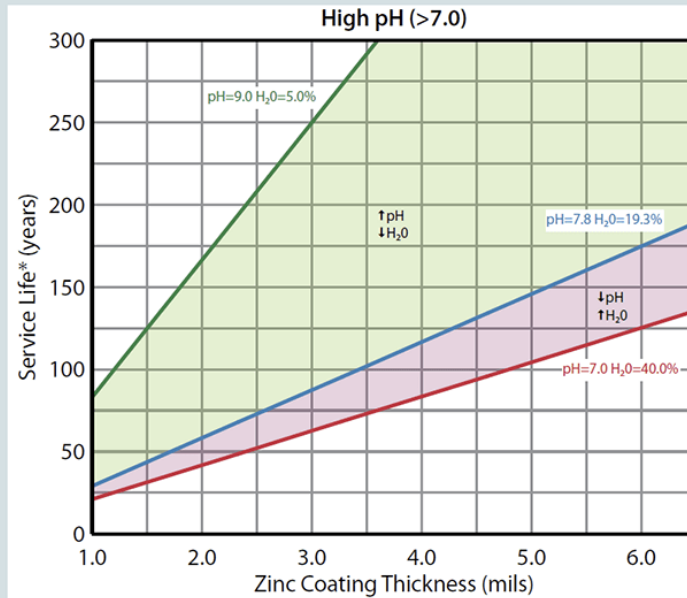
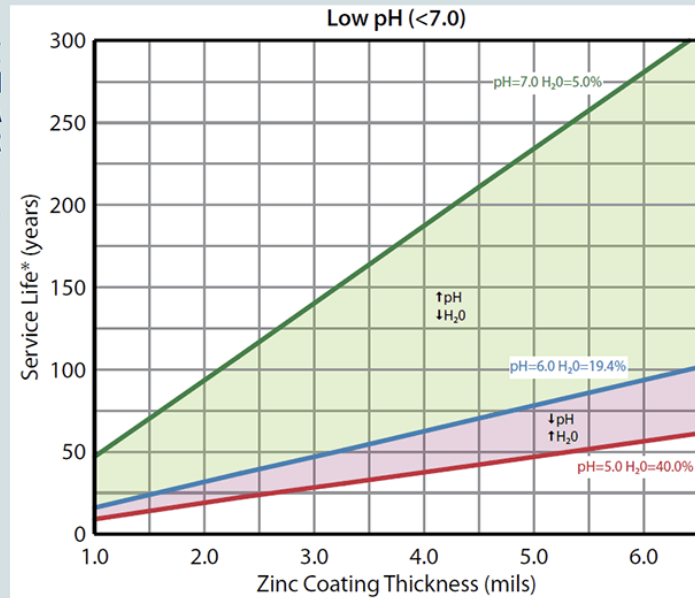


CHART 4



* Service life is defined as the time to necessary part replacement or underground maintenance.

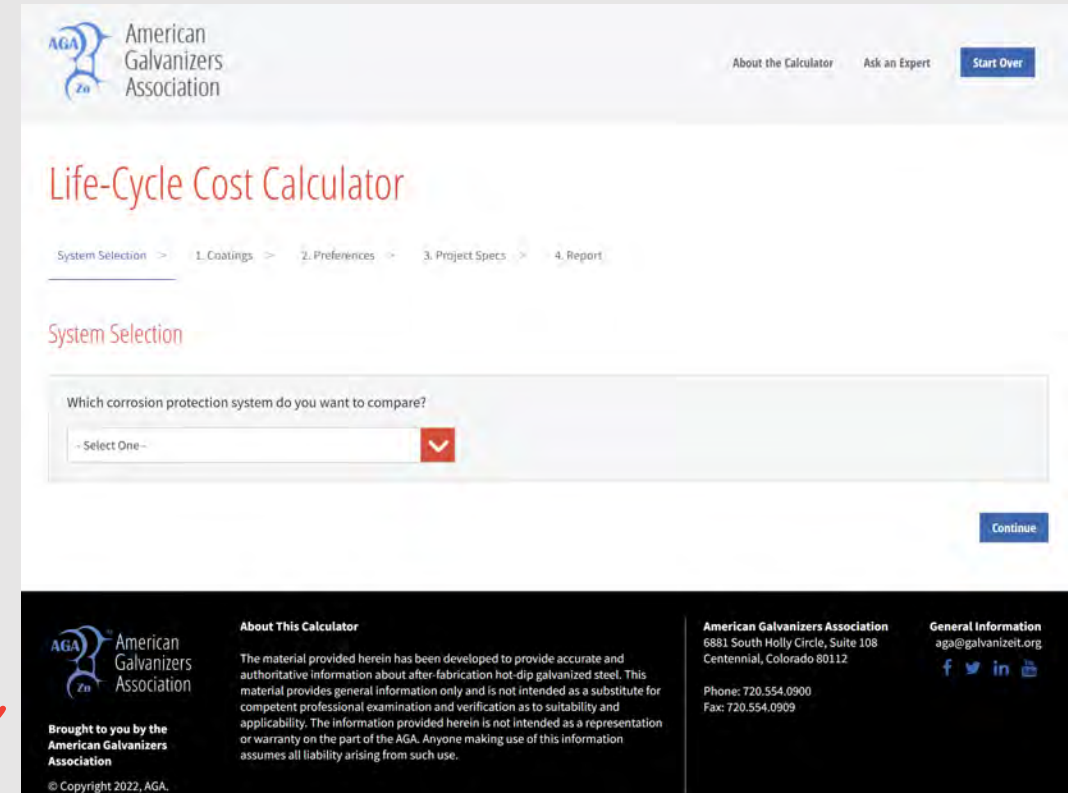
1 mil = 25.4 μm = 0.56 oz/ft²

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Life-Cycle Cost Calculator

- Life-Cycle Cost Savings
 - Total cost throughout project life
 - Includes maintenance costs and time value of money (interest/inflation)
 - Often HDG initial cost IS life-cycle cost
- Life-Cycle Cost Calculator to ASTM A1068



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About the Calculator Ask an Expert Start Over

Life-Cycle Cost Calculator

System Selection > 1. Coatings > 2. Preferences > 3. Project Specs > 4. Report

System Selection

Which corrosion protection system do you want to compare?

- Select One -

Continue

About This Calculator

The material provided herein has been developed to provide accurate and authoritative information about after-fabrication hot-dip galvanized steel. This material provides general information only and is not intended as a substitute for competent professional examination and verification as to suitability and applicability. The information provided herein is not intended as a representation or warranty on the part of the AGA. Anyone making use of this information assumes all liability arising from such use.

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General Information
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LCCC: Inputs


PROJECT SIZE
Enter amount of steel to be coated.

ft² tons

EXPECTED LIFE-SPAN
Amount of time before this structure is no longer maintained or in use.

Years

STRUCTURE TYPE
Specify the size and/or complexity of the structure.

- Select One - 

MEMBER TYPE
Select the project's structural makeup.

Typical mix size/shapes
250 ft² / ton

Large Structural
100 ft² / ton

Medium Structural
200 ft² / ton

Light Structural
400 ft² / ton

Light Trusses
500 ft² / ton

SERVICE LIFE ENVIRONMENT
Select the environment that represents your project's location.

Rural
Mild/Low Corrosion (C2)

Industrial
Moderate/Medium Corrosion (C3)

Heavy Industrial
Severe/Very High Atmospheric Corrosion (C5-I)

Seacoast
Very High Atmospheric Corrosion (C5-M)

LCCC: Reports

Life-Cycle Cost Calculator

System Selection > 1. Coatings > 2. Preferences > 3. Project Specs > 4. Report

Cost-Comparison Report

Review and customize before printing

Cost-Comparison Report

The cost of galvanizing vs. a paint system

Cost Comparison

HDG vs. IOZ/Epoxy/Polyurethane

	HDG	Paint System
Initial Cost		
Per ft ²	\$2.16	\$4.98
Total	\$108,000.00	\$249,050.00
Life-Cycle Cost		
Per ft ²	\$2.16	\$31.39
Total	\$108,000.00	\$1,569,500.00
AEAC		
Per ft ²	\$0.07	\$1.08

For this project...
HDG Life-Cycle Cost Savings: 93%

DETAILED COST COMPARISON

HDG vs. IOZ/Epoxy/Polyurethane

Cost Of Galvanizing	Today's Cost	Net Future Value	Net Present Value
Original Galvanizing	\$2.16	\$2.16	\$2.16
Total Price / ft²	\$2.16	\$2.16	\$2.16

Cost Of Paint System	Today's Cost	Net Future Value	Net Present Value
Original Painting	\$4.98	\$4.98	\$4.98
Touch-Up - Year 21	\$2.49	\$5.68	\$3.05
Maint. Repaint - Year 31	\$4.48	\$15.42	\$6.08
Full Repaint - Year 42	\$6.47	\$43.97	\$12.71
Touch-Up - Year 63	\$2.49	\$29.47	\$4.58
Total Price / ft²	\$22.91	\$99.52	\$31.39

PRINT PREVIEW
CUSTOMIZE REPORT

Project Name

Subtitle

Your Company's Name

Address

City, State & Zip

Your Name

Title

Tel.

Email



STRUCTURAL DESIGN

STEEL TYPES & SIZE | MITIGATING DISTORTION | CONNECTIONS

OGDENSBURG-PRESCOTT BRIDGE REHAB

Ogdensburg, NY | 2021

442 tons – Main span bridge
decking, structural steel floor
beams and stingers



Material Considerations

- Galvanizing temperatures: no change in steel properties (i.e. chemistry, tensile strength, yield strength, or micro-structure)
- AISC prohibits hot-dip galvanizing of some high performance steels thermally treated to enhance strength
 - ASTM A709/A709M HPS 70W and HPS 100W
- High tensile strength steels (> 150 ksi)
 - Risk of hydrogen embrittlement; use alternative surface preparation methods
 - Consult ASTM A143



Material Handling at the Galvanizing Plant

- Average kettle length in North America is 40 feet; some are 50-60 feet
- Design in modules to fit kettle size; consider progressive dipping for large items
- Galvanizers use hoists, cranes, and baskets for small items
 - Provide temporary/permanent lifting points to facilitate handling and avoid unsightly marks.
- **Consulting with galvanizer ensures design compatibility**
- For large items, ensure weight does not exceed max load capacity of handling equipment



Progressive Dipping

→ Depends on:

→ Kettle dimensions

→ Part dimensions

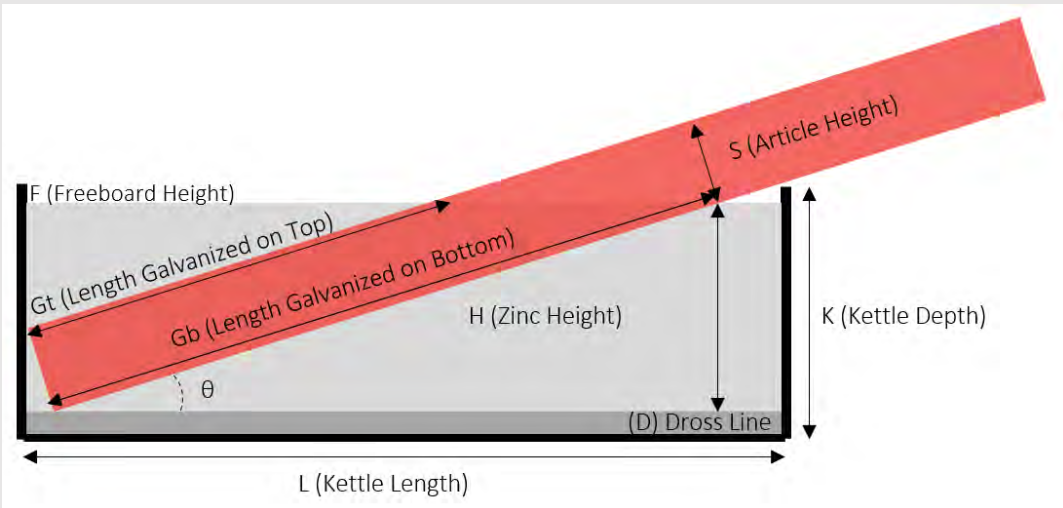
→ Material handling capabilities
(layout, cranes)

→ Managing Expectations:

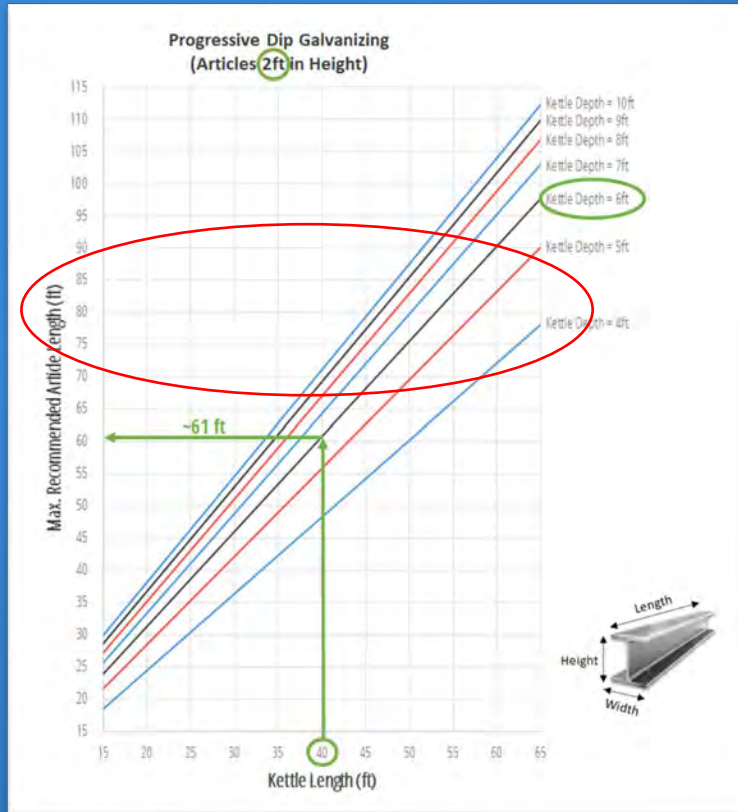
→ Overlap line appearance and roughness

→ Uneven heating

→ Increased susceptibility to warpage



AGA Resources for Progressive Dipping



Galvanizer Locator
(sort by Kettle Size)

Search Results:

Address/Zip State/Province Company Name

Search Locations by Address/Zip

77584 100 miles SEARCH

This listing only shows the dimensions of the galvanizer's kettle (bath), and does not indicate the maximum material size that can be galvanized. Please contact the galvanizer for more information on capacity limits.

Galvanizers:

Filter by: Length 0-24 25-34 35-44 45-54 55+
Width 0-4 5-7 8+
Depth 0-5 6-7 8-9 10+

Valmont Coatings - United Galvanizing
6123 Cunningham Rd Houston, TX 77041 United States Phone: (713) 466-4161 Website
Kettle(s) (L x W x D): 61' x 7'3" x 7'3" 42' x 5' x 6'

AZZ Galvanizing - Houston West
9103 fairbanks,N.Houston Houston, TX 77064 Phone: (832) 467-3772 Website
Kettle(s) (L x W x D): 62' x 8' x 10'

Progressive Dip Charts

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Protecting Steel for a Sustainable Future

Progressive Dip Calculator

USER INPUTS

Enter Kettle Dimensions:
K (Kettle Depth) 72 inches
L (Kettle Length) 600 inches
W (Kettle Width) 60 inches

Enter Article Dimensions:
(S) Height 34 inches
Length 780 inches
Width 1.6 inches

Enter Properties of Zinc Height:
Dross Line Height 8 inches
Freeboard Height 4 inches
If unknown: use dross height = 8 in. and freeboard = 4 in.

Allowable Angles in the Bath:
θ minimum 6.1 °
θ maximum 6.3 °

Can This Article be Fully Galvanized? YES ✓

Article Orientation: |

Dip Method:
Progressive Dip

F (Freeboard Height)
Gt (Length Galvanized on Top) = 245in
Gb (Length Galvanized on Bottom) = 562in
H (Zinc Height) = 60in
K (Kettle Depth) = 72in
L (Kettle Length) = 600in
 $\theta = 6.1^\circ$

Gt (Length Galvanized on Top)
OVERLAP LINE
Gb (Length Galvanized on Bottom)
Gt + Gb (Max. Progressive Dip Length) = 807.1in

Progressive Dip Calculator

Jesup Bridge

Jesup, IA | Installed in 2013 – Galvanized beams, diaphragms, W-beam rail, bolts and rebar.



Winter 2013



Spring 2024

→ **Initially, the progressive dip lines had a dark appearance and rough texture compared to the surrounding coating appearance, but after 10 years of weathering, the progressive dip line softened greatly as the zinc patina developed and provided a matte-gray color.**

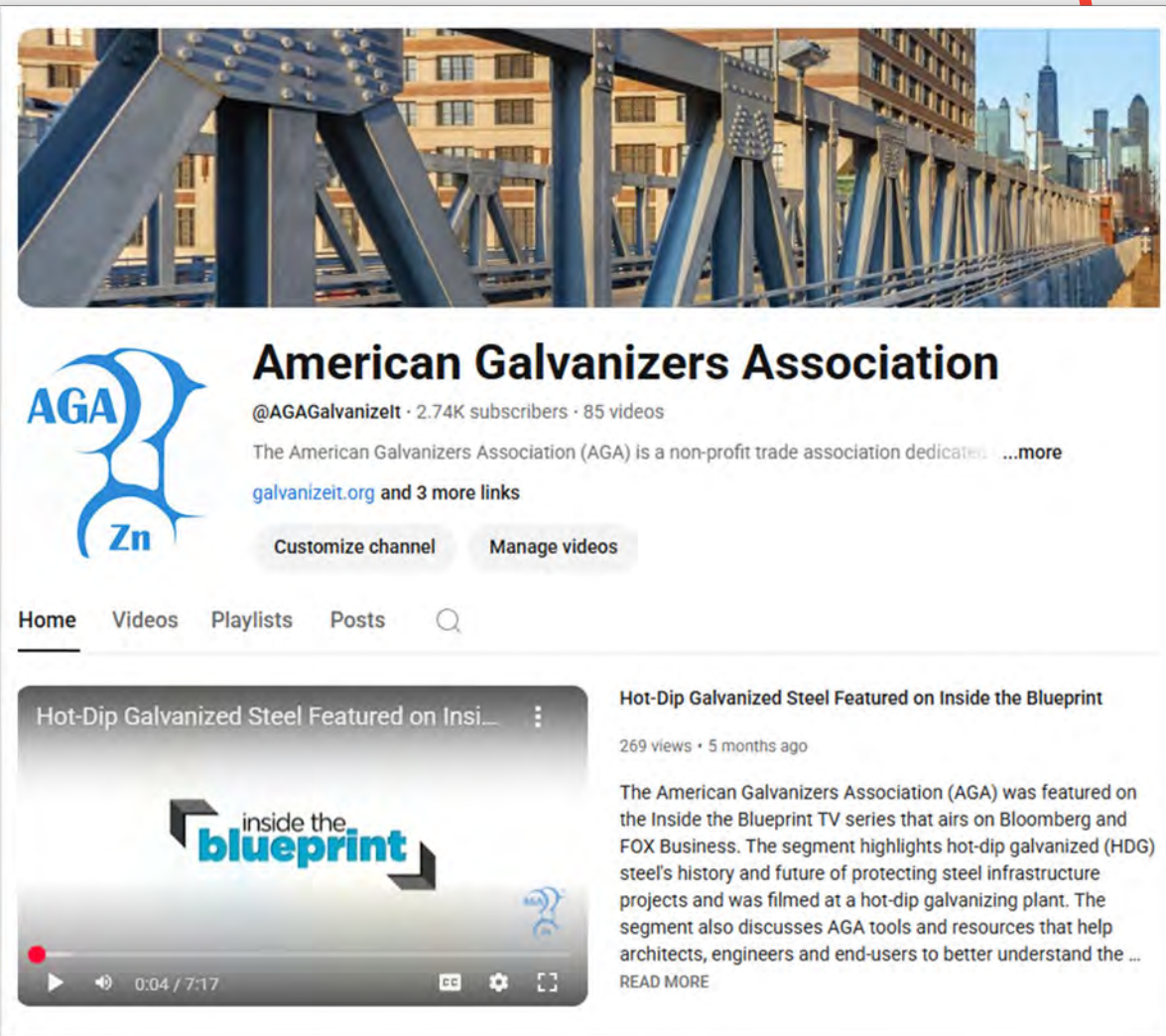
Options for Long Spans

- Hybrid zinc coating systems (HDG + TSZ metallizing) for mixed-size projects
 - TSZ for large, accessible steel articles / HDG for steel articles that fit in kettle
 - Maximize cost efficiency
 - Leverage superior protection of zinc coatings
- Galvanize smaller components (cross frames, splice plates, etc.)



YouTube Channel

- Interviews with architects, engineers and other end-users to get their take on how HDG has performed
- At least 10 years of service
- Riviere Cochon Gras Bridge
 - <https://www.youtube.com/watch?v=iJ7qXkV6WDI&t=25s>
- Buffalo Creek Bridge
 - <https://www.youtube.com/watch?v=JpSJ4hi7r-w>
- Irondequoit Bay Seasonal Bridge
 - <https://www.youtube.com/watch?v=bEhkHevhbJw&t=1s>
- Stearns Bayou Bridge
 - <https://www.youtube.com/watch?v=3FoA7GOIHGk>
- HDG Reinforcing Steel in Concrete
 - <https://www.youtube.com/watch?v=NN-BeG4JbII>



AGA
Zn

American Galvanizers Association

@AGAGalvanizeit · 2.74K subscribers · 85 videos

The American Galvanizers Association (AGA) is a non-profit trade association dedicated to...
galvanizeit.org and 3 more links

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Hot-Dip Galvanized Steel Featured on Inside the Blueprint

269 views · 5 months ago

The American Galvanizers Association (AGA) was featured on the Inside the Blueprint TV series that airs on Bloomberg and FOX Business. The segment highlights hot-dip galvanized (HDG) steel's history and future of protecting steel infrastructure projects and was filmed at a hot-dip galvanizing plant. The segment also discusses AGA tools and resources that help architects, engineers and end-users to better understand the ...

READ MORE

Inspection

- Steel inspected after galvanizing to verify conformance to specs
- Visual inspection with naked eye
- Coating thickness checked by magnetic thickness gauge
- Inspection of HDG Steel Products Guide
- [AGA Online Inspection Course](#)
- Download free Inspection App
 - galvanizeit.org/mobile



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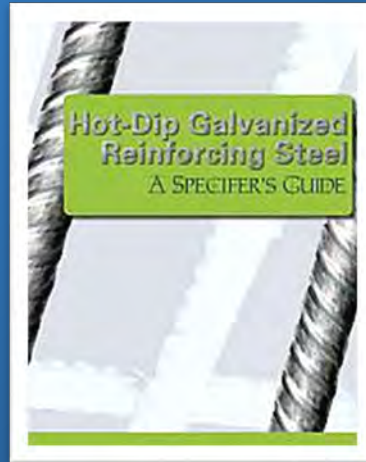
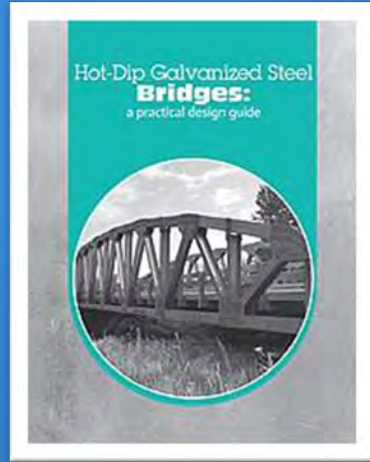


 Inspection of HDG Products Guide (PDF)



Publications

More than 40 pubs available | Download free PDFs online



→ **Bridge Specific Publications**

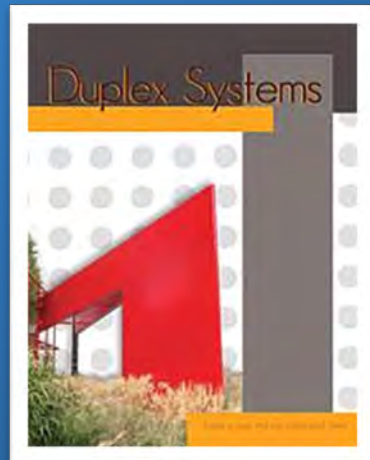
→ **Hot-Dip Galvanized Steel Bridges: A Practical Design Guide**

→ **Hot-Dip Galvanized Reinforcing Steel: A Specifier's Guide**

→ **Duplex Systems: Painting over HDG**

→ **Inspection of Hot-Dip Galvanized Steel Products**

→ **Hot-Dip Galvanizing for Sustainable Design**



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→ Live Q&A

→ galvanizeit.org/webinar

→ On-Demand Course

→ Over 12 course available

→ Lunch & Learn

→ US and Canada Only

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COLLABORATION & COLLECTIVE EFFORTS

PARTNERING ORGANIZATIONS

HILTON COLLEGE STATION, TX REMODEL

College Station, TX | 2023

170 tons – Columns, Braces,
Sun Shades



Short Span Steel Bridge Alliance (SSSBA)

- Established in 2012
 - AISI, NSBA, Professors, Bridge Manufacturers, County Engineers
- Target: Bridges up to 140 feet
 - County/Local “off system” bridges
 - Size Limitations & Headaches reduced
- Results
 - Press-Brake Tub Girder/Folded Plate
 - Galvanizing “preferred” solution



Rebar Focus Group

- AGA Subcommittee focused on growing the HDG rebar market
- Dedicated website for galvanized rebar information
 - Performance, Mechanical Properties, Field Handling
 - Standards
 - Case Studies
 - Publications
 - FAQs
- galvanizedrebar.com



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[Standards](#)

[Case Studies](#)

[Publicat](#)



Galvanized Rebar: It Works

[Learn How](#)



Bridge Resources

- Push back on increased marketing for Uncoated Weathering Steel (UWS)
 - Bridge Washing calculator (coming soon)
 - Demonstrate the maintenance costs for UWS previously marketed as no maintenance
 - HDG Bridge Design Guide (English)
 - Mirror the comprehensive NSBA guide on UWS
 - Translation to Spanish pending more members

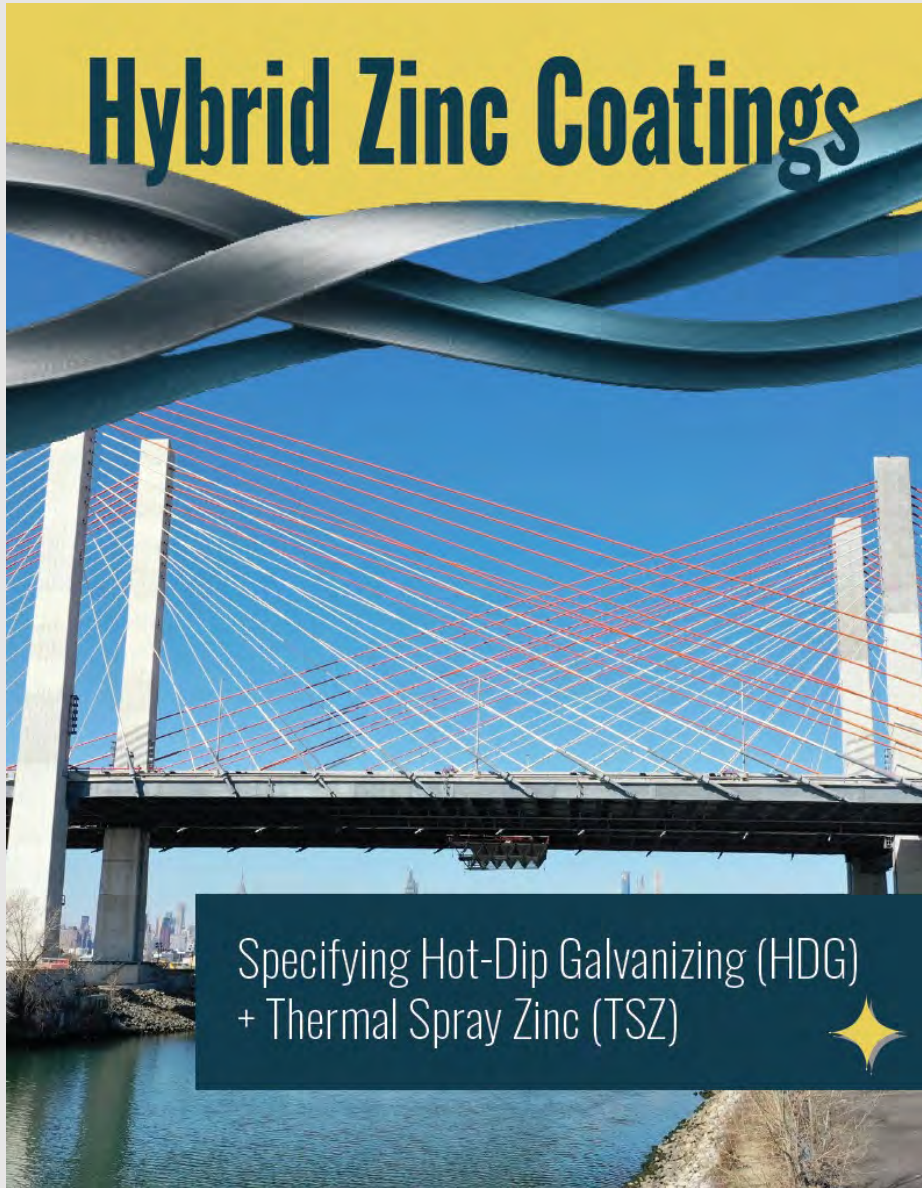
Hot-Dip Galvanized Steel Bridge Design Guide

- A comprehensive guide covering best practices, design considerations, performance expectations, and maintenance strategies for galvanized steel bridges.
- Intended for engineers, owners, fabricators, and detailers, it serves as a trusted, go-to resource for hot-dip galvanized (HDG) bridge applications.



HOT-DIP GALVANIZED STEEL BRIDGE DESIGN GUIDE





Hybrid Zinc Coatings Guide

- Introduces the Hybrid Zinc Coatings guide, helping specifiers effectively combine HDG and thermal-spray zinc (TSZ) on bridge projects.
- Establishes the first formal framework for using HDG and TSZ together, outlining key benefits and best practices.
- Includes real-world case studies demonstrating successful hybrid coating applications.



A construction site in a wooded area with bare trees. A large steel beam is being lowered into place by two yellow slings. Several workers in safety gear are visible on wooden forms and scaffolding. The foreground is a rocky embankment.

FIXING ACCESS TO RURAL MISSOURI (FARM) BRIDGE PROGRAM

Missouri | 2023





USACE FORT WINGATE BRIDGE REPLACEMENT

Gallup, NM | 2022

52 tons – Press-brake-formed steel
tub girder: 8 beams weighing
12,600 lbs. each





GOVERNOR MARIO M. CUOMO BRIDGE

Tarrytown, NY | 2017

59,600 tons – Channels, conduit supports, walkway safety rail, overhead sign structures, walkway supports, rebar, drain scuppers and gratings





STEARNS BAYOU BRIDGE

Ottawa County, MI | 1966

250 tons – Rail panels, and tube rail



SUMMARY





QUESTIONS?

GALVANIZEIT.ORG



American Galvanizers Association
Protecting Steel for a Sustainable Future

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